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The Taxonomic Status of *Dineutus serrulatus* and *Dineutus analis* in North America (Gyrinidae: Coleoptera)[1]

By F. E. Wood[2]

The genus *Dineutus* in North America is represented by a number of common species that, since the study by Roberts (1895), have been recognized fairly easily. Roberts' taxonomic work is reflected in nearly every species, and his concepts have been accepted so widely that a few errors in his work have not been apparent.

An example of this is *Dineutus serrulatus* LeConte (1868), a well-known lotic species described from one male and one female from the middle and southern states respectively. This form was recognized by its broadly oval shape, which is slightly narrowed in front, the strong, sharp tooth on the front femur of the male, and the serrulate apices of the elytra. It was characterized further by Roberts (1895) as having, among other things, the "surface polished black" and the "under surface chestnut-brown." A key and complete description by Roberts, accompanied by good illustrations of the male genitalia and the male and female elytral apices, established *D. serrulatus* as an easily recognized species from Florida.

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The species *Dineutus analis* described by Régimbart (1882) from Texas was not defined so clearly. It was characterized as follows: oval, slightly narrowed anteriorly; bronzed above; reddish black below, sides of the next to last abdominal segment and the last segment entirely rufous; male anterior femur unidentate. Régimbart compared the four specimens (two males and two females) from which he described the species with *D. americanus* (Say) (=*D. assimilis* Kirby) and *D. emarginatus* (Say).

Roberts (1895) redescribed *D. analis* from 20 specimens, from "Hab.-Texas," and called attention to the serrulate elytral apices that Régimbart did not include. Roberts also compared *D. analis* with *D. serrulatus* LeConte, separating the two by stating that *D. analis* was less convex, more bronzed above, with a different outline of the elytral apices, a weaker femoral tooth, finer serration of the elytra, and with undersurface dark brown. Roberts' key separated *D. serrulatus* and *D. analis* essentially by the difference in color of the venter.

Since the papers by Régimbart (1882, 1884, 1892, 1902, 1907) and Roberts (1895), only Hatch (1930) and Young (1954) have compared the two species. The portion of the 1930 paper by Hatch concerning these species is principally a key. Young discussed the species of *Dineutus* in Florida and stated (pp. 148–150) that he did not recognize *D. analis* among his Floridian specimens. He further stated that he might have mixed *D. analis* with *D. serrulatus* and that some specimens identified as *D. analis* were to him indistinguishable from *D. serrulatus*.

Régimbart in his 1882 description of *D. analis* overlooked the elytral serration in this form as he did also in the case of *D. carolinus* LeConte, when he synonymized that species with *D. emarginatus* (Say). Roberts, in redescribing the species, cleared up these oversights and the concepts of Roberts became those of Régimbart in his later papers (1902, 1907). At the same time, Roberts' interpretation of *D. serrulatus* delimited that species as being the form with reddish-brown venter and toothed male profemur found in Florida. In deciding this, Roberts used specimens only from Florida for the latter form and specimens only from Texas for *D. analis*.

Recently, specimens from drainage ditches in southeastern Missouri were found to run to *D. analis* in the keys of Roberts and Hatch, but the male and female genitalia were those of *D. serrulatus* (figs. 1, 2). Further study of the species of *Dineutus* in North America revealed that this population extended from eastern Texas north to southeastern Missouri and south to western Florida, where it intergraded with *D. serrulatus*.

In my analysis of these populations, it appears that Roberts' concept of *D. analis* is represented by the dark ventered form of *Dineutus* ranging from Texas to western Florida. This was confirmed by comparison of these specimens with a female paratype of *D. analis* from the collection of Régimbart. Also confirmed was the suspicion that the illustration of the male genitalia of *D. analis* in Roberts' 1895 paper (his Plate VI–10b), drawn for him by Professor John B. Smith (Roberts' p. 281) was incorrect and in fact did not apply, as drawn, to any species of American *Dineutus*. The female genitalia, although not as distinct as the male, nevertheless offer good diagnostic characters, and the female genital lobes of Régimbart's paratype are the same as those of Roberts' (and later authors') concept of *D. serrulatus* from Florida. This, with other morphological characters, indicates that the two forms are conspecific and necessitates the following changes in nomenclature.

***Dineutus serrulatus* LeConte**

***Dineutus serrulatus serrulatus* LeConte**

Dineutus serrulatus LeConte, 1868, pp. 366, 367.—Hatch, 1925, p. 106.

Dineutus (*Cyclinus*) *serrulatus*.—Ochs, 1926, p. 121.—Hatch, 1930, pp. 18, 20–22.—Young, 1954, pp. 143, 145, 148–150.

Dineutes serrulatus.—Schwarz, 1878, p. 438.—Régimbart, 1882, p. 415; 1884, p. 469.—Severin, 1889, p. 154.—Régimbart, 1892, p. 739.—Roberts, 1895, pp. 279–282, 286.—Régimbart, 1902, p. 4; 1907, p. 145.—Ahlwarth, 1910, p. 7.—Leng and Mutchler, 1918, pp. 95, 96.—Blatchley, 1919, p. 316.—Leng, 1920, p. 82.—Brimley, 1938, p. 132.

Length 9–12 mm; broadly oval, more or less narrowed anteriorly; dorsal surface shining, black, striae faint; exterior apical angle of elytra moderately sinuate, moreso in the female, elytral apices slightly dehiscent at suture, sutural angles obtuse, slightly sinuate, not produced, serrulate; undersurface shining, uniformly castaneous; hypomera orange; anterior leg castaneous; anterior tibia narrow at basal one-fourth to one-third, then broadened and subparallel to apex, apex truncate, exterior apical angle rounded, female less so than male; anterior femora of male always with a distinct, acute tooth.

Because lectotypes have not been specified for LeConte's two specimens, I hereby designate the following:

Hololectotype: a male in the Museum of Comparative Zoology, the pin bearing a pink disc with a red label designating "Type 6094" and a white paper label on which is written "*D. serrulatus*" in ink. The pink disc, LeConte's indication of "middle states" on the hololectotype, is unexplainable since this subspecies is found only in Alabama, Florida, and Georgia, and its boundaries are well limited. "*D. serrulatus*" is written in cursory writing and in LeConte's hand (Horn and Kahle, 1936).

Allolectotype: a female in the Museum of Comparative Zoology with a pin bearing an orange disc and a white paper label on which is written "*serrulatus* 2," which does not appear to have been written by LeConte.

***Dineutus serrulatus analis* Régimbart, new status**

Dineutes analis Régimbart, 1882, p. 416; 1884, p. 469.—Severin, 1889, p. 151.—Régimbart, 1882, p. 739.—Roberts, 1895, pp. 286, 287.—Régimbart, 1902, p. 4; 1907, p. 146.—Ahlwarth, 1910, p. 4.—Leng and Mutchler, 1918, p. 95.—Leng, 1920, p. 82.

Dineutus (*Cyclinus*) *analis*.—Ochs, 1926, pp. 121, 137.—Hatch, 1930, pp. 18, 20–22.—Young, 1954, pp. 143, 145, 148–150.

Same as the nominate subspecies except dorsal surface bronzed; sutural angles of the elytra produced; undersurface shining; thoracic sterna dark castaneous to piceous; abdominal venter piceous, caudal three segments laterally rufotestaceous, the last almost entirely; anterior leg dark castaneous; anterior male femur toothed.

Range and Variation of the Two Subspecies

Dineutus serrulatus is a coastal plains species and apparently occupies small streams below 500 feet elevation from South Carolina to Texas. It consists of two subspecies, one eastern and one western (fig. 11).

The western subspecies *D. s. analis* inhabits the wider of the two subspecific ranges. In the west, it is found in eastern Texas from Kenedy County on the Gulf Coast inland to Brazos County and from there northeastward to Hempstead County, Ark. A large series of specimens from Hope, Ark., in Hempstead County collected from July 1 to July 19, 1925, by L. Knobel contained 16 specimens (collected on July 3) apparently from a locale different than that of the other specimens. The venter, underside of legs, and external genitalia of these individuals are strikingly, uniformly black. This color combination was not observed elsewhere. From southwestern Arkansas the apparent western boundary proceeds north to Stoddard County, Mo. In Missouri, specimens were collected from large drainage ditches and streams that drain into the St. Francis and Mississippi Rivers. From the Missouri "bootheel" area *D. s. analis* follows the Ohio River valley to the northernmost point of the known range, Orange County, Ind. Three large specimens, one male and two females, collected by T. S. Acker at West Baden, Ind., Sept. 27, 1961, are 12 mm in length and perhaps were collected at an elevation higher than 500 feet. From Orange County, Ind., the northern boundary descends south and east to Bullitt County, Ky., and then westward to Christian County, Ky., along the southern boundary of the valley.

The range then drops south along the Tennessee River and into Colbert County, Ala., where the Tennessee River Valley is a finger projecting eastward into northern Alabama. In southern Alabama and western Florida the range is narrowed to a width of about 125 miles by the Appalachian Mountains. Here, in this restricted area, occur intermediates in which the color of the venter changes from dark to light. Half of the specimens in series from Santa Rosa County, Fla., and from Houston County, Ala., have characteristic piceous venters (fig. 5). Along the Chattahoochee River in Alabama, specimens with light castaneous venters appear, but west of that area, in the same county (Houston), specimens are taken with piceous venters. In the finger of the Chattahoochee projecting north along the Alabama-Georgia border, specimens from Lee County, Ala., have light castaneous abdominal sterna.

Specimens from Houston County, Ala., collected by Mr. George Folkerts of Auburn University, suggest distribution patterns worthy of special note. These specimens are from two localities in Houston County. One site is the Chattahoochee State Park in the very southeastern corner of the county, where *D. s. serrulatus* was collected. The other is Bazemore Grocery, the location of a small spring from which *D. s. analis* was taken. This location is only 10–12 miles west of Chattahoochee State Park in the south-central part of the county.

The Bazemore Grocery spring flows into Cowarts Creek, a small tributary of the Chipola River, which merges with the Apalachicola River in Florida. Small streams in the Chattahoochee State Park from which *D. s. serrulatus* was collected drain into the Chattahoochee River, which in turn meets the Apalachicola River at the southwestern corner of Georgia.

During the Pleistocene, the Chipola River formed a distinct, separate drainage that flowed into the Gulf of Mexico. This situation precluded any fresh water connection with the Apalachicola River (Folkerts, 1966, in litt.) and may well have produced isolation that resulted in subspeciation. Young (1954, pp. 25–27) has discussed this area, its various plant refuges, and other instances of isolation.

Two collections of *D. serrulatus* lie outside the projected range of this species—one female of *D. s. analis* from El Paso, Tex. "AMNH Acc. 4858," and two males of *D. s. serrulatus* from Medora, Reno County, Kans. The latter most likely are mislabeled.

The boundary of *D. s. serrulatus* extends from Santa Rosa County, Fla., and Houston County, Ala., north to Lee County, Ala., eastward to Bibb County, Ga., and northeast to Baldwin County, Ga., where forms with slightly darker venters occur. The northern limit of the range of *D. s. serrulatus* is Richmond County, Ga. It then extends

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southeastward along the Savannah River to Chatham County on the Atlantic Coast. Collecting in South Carolina may extend the range into that state.

Specimens of *D. s. serrulatus* from the southwestern limit of its range—Santa Rosa, Walton, and Calhoun Counties, Fla.—present a dark, smokey, castaneous venter that becomes reddish or castaneous in Franklin County, throughout the remainder of Florida, and throughout most of Georgia. The western border of the range of *D. s. serrulatus* then appears to be the eastern margin of the Piedmont Plateau.

Dineutus serrulatus analis is somewhat more variable over its large range than is *D. s. serrulatus*. The elytral apices of *D. s. analis* may be obtuse at the sutural angle (fig. 6), but they usually are produced (fig. 7). Both conditions can occur in a single series. The male profemoral tooth usually is prominent (fig. 3), but in a single series it may be either apparent or merely the truncation of a femoral carina (fig. 4). The external apical angles of the protibiae are rounded (fig. 10). This character is more apparent in the male than in the female, and in some female specimens the angle may even be distinct, but never produced. Bronzing of the dorsum is the most common condition, but specimens with a black dorsal surface are not uncommon.

Dineutus serrulatus serrulatus appears to be more constant in its characters than does the western subspecies. The elytral apices are not produced (fig. 8), but occasionally a tendency toward that condition may be seen in a few specimens with a more sinuous elytral apex than usual (fig. 9); in fact, this is the case with both of the type-specimens. The profemoral tooth of the male is always distinct and acute. The shining castaneous venter varies somewhat. In western Florida it appears uniformly darker, rather less reddish and slightly more brown, but never approaching piceous.

The differences in ventral coloration in species of *Dineutus* having a light venter appear to be associated closely with the tissue underlying the integument. The integument tends to be more or less transparent in these forms, and the color is largely dictated by underlying fat, muscle tissue, and internal organs that are darkened slightly by various brown or reddish pigments in the integument. Heating the specimens in water to relax them for genitalia extraction often detaches the underlying tissues from the integument, causing a darkening in color. Preserving methods and materials also can alter color, and, where the tissues are separated from the integument, the space separating them can be observed with correct lighting and magnification. Other factors affecting ventral color are the pygidial sacs of the repugnatory organ (see Brinck, 1955, for discussion of internal anatomy) and the exudations of these organs and musculature of the genitalia.

The two pygidial sacs lie laterally between the caudal abdominal segments and release a white liquid when the live insects are disturbed. The effect of alcohol or drying on this exudate are unknown but the pygidial sacs turn white. This color may be altered or masked outwardly by pigment in the body fluids; nevertheless, it shows through unpigmented or lightly pigmented integument. Where the integument is very darkly pigmented, like the piceous portion of the abdomen of *D. s. analis*, internal tissues are masked completely; but where pigmentation is light or lacking (e.g., portions of the last three ventral abdominal segments), tissues show through, presenting a light color. In the uniformly dark specimens from Hope, Ark., there is no absence of pigment in the caudal ventral segments, and all the ventral sterna are pigmented equally. The head, pronotum and elytra, and terga of the last three abdominal segments are pigmented heavily and darkly, but the thoracic sterna are pigmented like the abdominal sterna. The heavy and broadly attached thoracic muscles do not separate easily from the ventral integument; furthermore, they fill the thoracic cavity so completely that there is little change in ventral thoracic coloration regardless of treatment. The actual piceous pigmentation of most of the venter of *D. s. analis*, therefore, allows for little change in ventral coloration, except caudally, while the more lightly pigmented venter of *D. s. serrulatus* permits variation in color, depending on how the specimen has been treated.

The protibiae of *D. s. serrulatus* are rounded at the exterior apical angle. This character, as with the western subspecies, is more evident in the male but is constant in both sexes. The dorsum of the eastern taxon is usually black with an occasional bronze form occurring within a series. All specimens in both subspecies that are black dorsally show very faint bronzing under magnification, especially when viewed laterally and more especially on the lateral aspects of the pronotum and the head. The specimens studied (over 900) ranged from 9 to 12 mm in length (measured from the anterior margin of the clypeus to the elytral apices).

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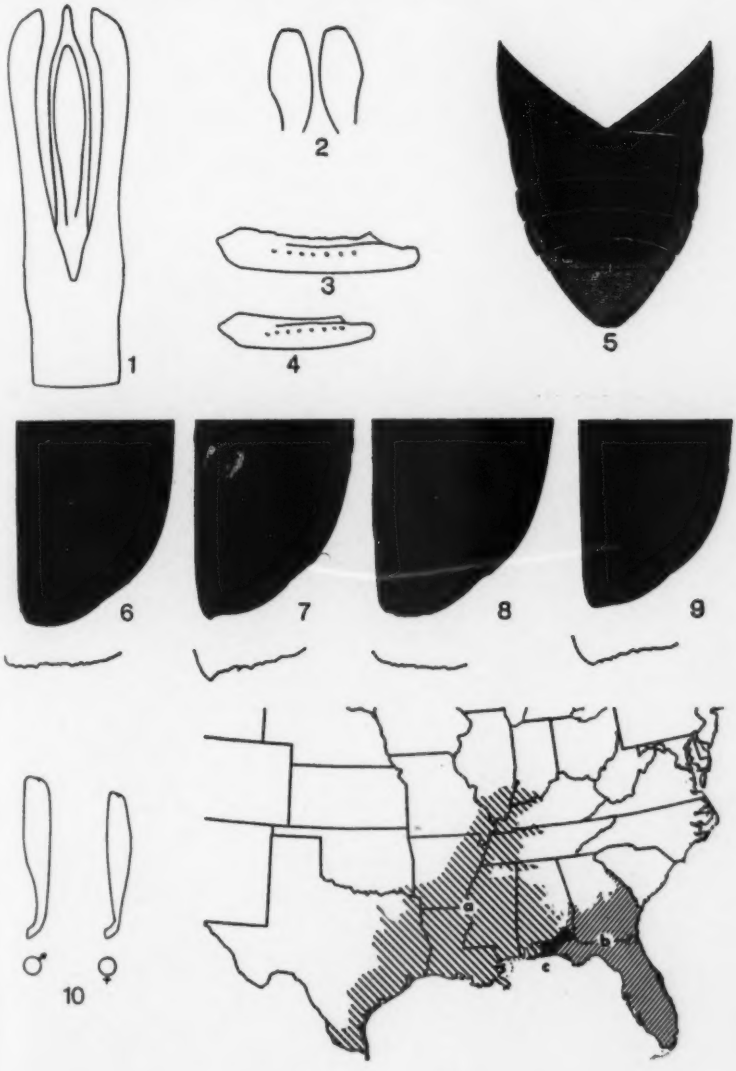

FIGURES 1–11.—*Dineutus serrulatus:* 1, male aedeagus; 2, female lateral lobes; 3, 4, male profemora, showing variation of profemoral tooth. *D. s. analis:* 5, venter; 6, 7, apical half of right elytron with serrulation of sutural angle enlarged. *D. s. serrulatus:* 8, 9, apical half of right elytron with serrulation of sutural angle enlarged; 10, male and female protibiae. Range: 11 (a = *D. s. analis;* b = *D. s. serrulatus;* c = area of overlap between subspecies).

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